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Schedule, Cost, and Profit Control with PERT

Schedule, Cost, and Profit Control with PERT

A Comprehensive Guide for Program Management

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II

To Marie-Jeanne, Philip, and Stephen

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Preface

The reader may ask: "Why a book entitled *Schedule, Cost, and Profit Control with PERT*? Isn't PERT (Program Evaluation and Review Technique) the name of a scheduling system designed for government programs, which is fairly straightforward in concept, and which has been thoroughly documented?"

By 1963 it seemed important to answer questions such as these in a book written for both top management and operating people in both commercial and government-based industries. In addition, within the worlds of government and education, it seemed clear that the significance of PERT Management Systems, as they have evolved through the period of 1963, had not been fully recognized. Readers of this book will soon discover that it is indeed concerned with the problems of planning and control in the three dimensions of schedule, cost, and profits, and that the basic approach is founded upon the technique of networking.

The frame of reference in which PERT is best applied is quite different from the situation in which classical control methods are used. Thus the reader will find throughout the book an emphasis on the problems of *program management*, as distinguished from those of established *functional management*. Perhaps a quotation from Jay W. Forrester, in the introduction

of his volume on *Industrial Dynamics*, sets the theme of my book as well as it can be stated: *

Until now much of management education and practice has dealt only with components. Accounting, production, marketing, finance, human relations, and economics have been taught and practiced as if they were separate, unrelated subjects. Only in the topmost managerial positions do managers need to integrate the separate functions. Our industrial systems are becoming so large and complex that a knowledge of the parts taken separately is not sufficient. In management as in engineering, we can expect that the interconnections and interactions between the components of the system will often be more important than the separate components themselves.

In this book we are explicitly concerned with the planning and control problems associated with special-purpose or "one-time-through" programs, as opposed to continuous production operations. In addition, we are concerned with the application of PERT techniques to areas of time, cost, and product performance, representing an integrated management approach to all three of these factors in modern programs.

The potential applications for such an integrated management approach range from the introduction of a new product in the commercial world to the acquisition of a large weapons system or a disarmament program. In between these categories there are a host of other applications, both large and small, where the full spectrum of PERT techniques described in this book may not always be applicable. Basically, however, the book emphasizes those aspects of PERT techniques which are involved in the actual management and execution of special-purpose programs of any complexity. The role of PERT in the areas of long-range planning and of early conceptual or decision-making phases is discussed, but the emphasis is on actual implementation of programs by industry. Nevertheless, the neces-

* Reprinted from *Industrial Dynamics*, 1961, p. 6, by Jay W. Forrester, by permission of The M.I.T. Press, Massachusetts Institute of Technology, Cambridge, Mass. All rights reserved.

sity for a close tie-in between aggregate or initial planning and PERT analysis is emphasized, for without this tie-in it is difficult for early planning efforts to have any real validity.

The treatment of the book is essentially historical. In Chapter 1 the developments of the 1950s leading to the evolution of networking techniques such as PERT and CPM are discussed. In Chapter 2 the methodology of networking, with PERT/TIME as the basic framework, is treated in detail. It is my hope that this chapter will prove informative, not only for the executive who thinks of PERT as "just a scheduling system" (or perhaps has not even been exposed to its basic methodology), but also to the PERT analyst and persons working directly with the technique who have not kept up with the latest developments in the field of PERT/TIME. In Chapter 3 the pros and cons and problems of implementation are discussed, from the point of view of both top management and operating-level management. In Chapter 4 the specific features and problems of PERT/COST are treated in detail, with emphasis on the requirements of the Department of Defense PERT/COST system. In this chapter I have attempted to cover the problems of PERT/COST from the point of view of the financial executive or controller, as well as the program manager and functional manager.

Chapter 5 covers some of the latest developments in PERT Management Systems. In particular it emphasizes their relationship to the formalized requirements of Project Definition, systems engineering, value engineering, and Configuration Management. This chapter was written especially for the managers of the large, complex development programs of our time; however, many of its principles are applicable to smaller programs.

In Chapter 6, methods of organizing for the implementation of PERT Management Systems are discussed; here the roles of both program management and a central PERT staff are treated. In the discussion of PERT and its relationship to profits, I have emphasized both commercial and government business in terms of data on actual applications and payoffs. I hope this section of

Chapter 6 will be of interest to management in both fields. When it comes to the difficult subject of the relationship of PERT to *multiple-incentive contracting*, however, it must be recognized that we are dealing with the problems of large, complex military and space development programs, which are planned and executed in the demanding environment of our times. This section should be of particular interest to contract managers in both government and industry.

Much of the subject matter covered in this book may raise questions concerning the degree of government influence over the management process in the defense and space industries. There is no question but that an entirely new relationship has developed between government and industry in connection with the conduct of the large, complex programs previously referred to; in connection with PERT reporting requirements, the line which the government normally should not pass is discussed in Chapter 4. It is important to emphasize, however, that the advantages of the use of PERT Management Systems are mutual; when they are properly applied by the industrial contractor, they can produce benefits for him as well as for the government. In fact, in the area of incentive contracting treated in Chapter 6, one may conclude that new opportunities are available for the superior contractor to earn profits which are more in line with established free-enterprise levels. It is, of course, too early to tell whether the objectives of incentive contracting and these beneficial results for industry will actually be realized.

The approach of this book is essentially pragmatic, largely because the proper application of PERT to problems of schedule, cost, and profit control is intrinsically a pragmatic one. Thus the "pure" operations researcher will not find much to challenge him here, with the possible exception of the conceptual model for the multiple-incentive contracting situation given in Chapter 6. In addition, the researcher in the field of R & D management problems will not find any extensive discussion of such areas as motivation and quality of personnel, propensity for risk taking, and techniques of communication. Researchers in this field should take note, however, of the rapid develop-

ments described in this book, which have outrun research efforts as a matter of vital necessity.

Finally, one may comment briefly on the social significance of the management systems described in this book. The possibility of producing a valid summarization of 30,000 network activities in a "condensed network" for the top industrial or government manager, as described in the section on network condensation and integration in Chapter 3, may have social significance for some. Nevertheless it is clear that these management systems are only tools for the manager at all levels, and that they will not replace him or the quality of his judgment. Readers with a social or philosophical bent may be interested in the discussion of objective-oriented planning, such as required by PERT, which is treated in the early part of Chapter 5. It should be clear from this discussion that PERT techniques are also applicable to problems of economic development and planning.

It is easy to decry the demands posed by PERT techniques and the complexity of its networks. Yet PERT is only a vehicle or mechanism for representing the very real complexities of the demanding undertakings of our time, which has been called the "age of massive engineering."

I wish to express my appreciation to the many people in my own company, and throughout the country in both government and industry, who contributed to this book. It would be impossible to name them all. In particular, however, I would like to mention the members of my EIA (Electronics Industries Association) Committee on PERT Management Systems; Mr. Charles Greer, who originated the conceptual approach to the handling of the profit dimension in Chapter 6 as a result of some unpublished work at M.I.T.; Mrs. Esther MacLeod, who typed the manuscript through all its revisions in the trying circumstances of a corporate headquarters office. Finally, it seems appropriate to acknowledge the support of my family, who accepted with forbearance the many weekends and holidays consumed in the preparation of this book.

Robert W. Miller